



NORTH STIRLINGS AND MID-UPPER
FRANKLAND-GORDON RIVER CATCHMENTS
REVEGETATION GUIDE



**Restoring biodiversity values on farmland through
direct seeding and seedling plantings**

BY WENDY BRADSHAW AND GEOFF WOODALL

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Photos

All photos used in this booklet supplied by Wendy Bradshaw, except for those on pages 10 and 11 supplied by Geoff Woodall.

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Australian Government





INTRODUCTION

Resilient farm ecosystems are vital for sustainable productivity and therefore profitability. Resilient farm ecosystems are a product of high levels of biodiversity.

Biodiversity is an all-inclusive term that includes interactive processes between the physical environment and living things.

It is about life, death and decay at genetic, species and ecosystem levels and is not just what happens in nature reserves!

PHOTO - Mixed plantings of alleys of biodiversity plantings provide windbreaks, stabilisation of creek-lines and habitat for beneficial species such as predatory invertebrates, insectivorous birds and pollinators. A combination of forage shrubs with perennial pastures in a paddock (towards rear of photo) has boosted production on a hillside seep that was turning into a salt scald.

Biodiversity provides stability of ecosystem function and therefore resilience to farming landscapes. A diversity of woody and herbaceous perennial plants adds stability to landscapes dominated by annual crops and pastures. They provide habitat for beneficial fauna that together help maintain ecosystem services such as soil formation, provision of food and shelter, pollination, cycling of nutrients, pest management, hydrological balance, a lovely place to live and much more.

A 'backbone' of native vegetation provides habitat for wildlife and adds resilience to farm ecosystems. Some might say that it just adds more 'roos', rabbits and foxes. And this is certainly likely: these are issues that need to be managed. The bigger picture is the health of the farm ecosystem and the farmer's vision for how they would like it to be now and in the future.

Resilience supported by biodiversity enhances the farm's capacity to buffer the damaging effects of disturbance such as storms, droughts, frosts, floods and plagues. Successful revegetation produces self-sustaining systems that have all of the key structural and functional elements necessary for successional processes to occur effectively.

This guide aims to provide methods as well as species guides that include key structural and functional elements of native vegetation communities of the mid-upper Pallinup River and surrounds. Vegetation communities are linked to associated soil types and landscape positions.

The capacity of the restoration work to evolve over time is enhanced by being linked to existing bushland, which enables more flora and fauna species to move around the landscape. An effort has been made to include a range of key species listed in the vegetation communities that are currently able to be grown from seed and / or seedlings.

SEED OR SEEDLINGS?

The revegetation of poor quality agricultural land is achieved by the planting of nursery raised seedlings and / or sowing native seeds (direct seeding). The direct seeding of native plants is now a reliable establishment technique, provided there is adequate practitioner competence and access to appropriate equipment. Technological improvements in both seeding equipment and native plant agronomy have led to improved reliability and uniformity of direct seeding. Some species, for one reason or another, should still be planted as nursery raised seedlings / rooted cuttings (e.g. *Adenanthos* and *Lambertia* species).

The technique of direct seeding can readily establish plant densities of 1000-5000 plants per hectare, which is ideal for creating structurally complex vegetation. Direct seeding can be a cheap establishment technique (as low as \$500 per hectare) but for most operators it has a higher risk of failure than the planting of nursery raised seedlings that are far more expensive to establish.

While robust systems and improved equipment have been developed, the main obstacle to reliable establishment is the fact that direct seeding of native seed requires a much higher level of competency than that required to plant a nursery raised seedling. The important factors that determine the success of a direct seeding operation are:

- » *practitioner competency*
- » *selecting the most appropriate sowing method, equipment and setup of equipment*
- » *understanding species suitability to proposed site*
- » *moisture management*
- » *appropriate pest and weed control*
- » *understanding site conditions (soils [pH, chemical history, and fertility], climate, land use history, pests and diseases, etc)*
- » *timing*
- » *germination characteristics and niche requirements of species*
- » *sowing depth*
- » *seeding rate and species mix*
- » *seed quality*
- » *seed preparation (breaking dormancy, inoculants)*

Practitioner Competency

People who are interested in the local flora are encouraged to develop skills in the area of direct seeding. It can take many years to develop reliable establishment skills and during this learning phase it is recommended that practitioners use direct seeding coupled with the planting of nursery raised seedlings to establish sites.

Often large numbers of species are involved, with highly variable seed size and shape, contrasting germination requirements and factors that can influence success or failure. For those people who are not interested in the local flora / revegetation it is recommended that appropriate people with expertise be used to provide technical assistance or contracting services.



Diverse understorey species will create better habitat than dense stands of trees that outcompete understorey. Prickly shrubs such as *Hakea prostrata* (left foreground), as well as bushy shrubs such as one-sided bottlebrush *Calothamnus quadrifidus* (and right understorey) provide habitat for small birds and beneficial predatory insects.

Planning for revegetation needs to be undertaken in context with the objectives of the landholder and whole-farm planning. A few examples of objectives might be to stabilise soil such as salt scalds or gutless sands, to create linkages with existing bushland and habitat for beneficial fauna such as insectivorous birds, bats and predatory insects and possibly for fauna that you wish to attract back to your property, to make the place look and feel great and promote healthier ecosystem function!

If targeting specific fauna such as small mammals, dense understorey will be needed. Stages of planning for revegetation include site assessment, organising resources to undertake the work, including seed and / or seedlings, machinery, funding and labour, and how to monitor achievement of objectives.



Where soil type and landscape position is suitable, revegetation that includes species such as banksias and hakeas can provide endangered species such as Carnaby's Cockatoo valuable additional food sources. Cockies are shown here feeding on *Banksia mucronulata* located on a gravel ridge west of Tambellup.



Information gathered at the site assessment informs revegetation design including site preparation, species selection and quantities of seed and / or seedlings, planting techniques and design, and threats to successful outcomes such as water-logging / salinity, rabbits, kangaroos and weeds. It is also a good time to consider necessary monitoring processes that track progress to achieve objectives and identify actions that need to be taken to mitigate threats.

When visiting site, ensure boots and equipment are clean prior to entering and leaving site to prevent spread of disease such as dieback (*Phytophthora cinnamomi*). See page 13 for information on hygiene protocols.

It is useful to have an aerial photograph showing site and adjacent landscape features / habitats such as remnant vegetation, wetlands, and existing fencing; a pick or shovel to check out soil type; and a camera to take reference photos.



Before and after photos are valuable for monitoring change following revegetation activities.

COLLECT THE FOLLOWING INFORMATION FROM SITE AND DESKTOP ANALYSIS

- » Objectives of the planting, including expected timing of planting
- » Location of site (with GPS coordinates to mark boundaries)
- » Landform and associated rocks if visible (e.g. granite outcrop, riparian, sand plain)
- » Soil type and colour of top-soil and sub-soil (sand/loamy, sand/clayey, sand/sandy, loam, loam/clay, loam/sandy, clay/loamy, clay/clay, with or without gravel), approximate depth of topsoil
- » Map different soil types
- » Condition of soil (e.g. compacted, % ground cover and type, evidence or threat of wind or water erosion) and hydrological features (e.g. water-logging, salinity, non-wetting)
- » Vegetation type (ie. the tallest dominant species that is known to grow on that soil type and landscape position e.g. flat-topped yate (*Eucalyptus occidentalis*))
- » Previous land use (e.g. grazing and fire history)
- » Paddock fertiliser and herbicide history
- » Are there factors that prevent the original vegetation being re-established (e.g. altered nutritional status, site now salt affected, altered soil pH)?
- » List weeds observed and abundance
- » An inventory of resources available for achieving objectives (e.g. identify matching vegetation type in bushland nearby that can be used as seed sources; machinery; labour; funding)
- » Methods of weed and pest control, preparation and planting technique
- » Once area to be revegetated is finalised, estimate the area to be revegetated to calculate quantities and cost of revegetation
- » Take before photos from a spot(s) that can be easily replicated later as a minimum monitoring and evaluation tool

SPECIES SELECTION



Sea rush *Juncus kraussii* thrives with upwelling of water in salt scald planted 1997 (left) showing recruitment 2012 (centre and right).

- 1 » Match the vegetation type identified in the site assessment process with the appropriate vegetation community listed at the end of this guide. It is emphasised that these lists are a starting point to guide the use of local species.
- 2 » Be sure to include the different layers of vegetation that occur with the target vegetation type e.g. Flat-topped yate woodland with bottlebrushes, paperbarks and rushes on winter waterlogging-prone soil.
- 3 » Include pioneer and coloniser species. Pioneer species are those that come up, often in large numbers after disturbance (such as fire), grow quickly, produce lots of seed and litter, and usually put nitrogen in the soil - and are often short-lived. That is, they set up the conditions for coloniser species that are slower growing and longer lived to establish. Examples of pioneer species are wattles (*Acacia* species), peas (eg. *Bossiaea*, *Kennedia*, *Senna*), native hibiscus (*Alyogyne*) and sheoak (*Allocasuarina*).
- 4 » Select a diverse mix of species in the lower, middle and upper storey to maximise habitat values (e.g. asynchronous flowering times, flower shapes and plant forms such as prickly, bushy, etc.) and resilience of the vegetation to be self-replacing over time (e.g. seeders and sprouters). Tree seedlings < 25% of overall planting with low, mid and tall shrubs, herbs, grasses and / or rushes making up the remainder. For information on seeding rates and mixes, see page 11.
- 5 » Seed collected from species in stands with large populations (more than 100-200 plants) will result in the highest quality revegetation sites. When this is not possible, seeds from smaller populations should be combined to ensure that newly restored populations have high genetic diversity. As a general rule, source seed from stands as close as possible to the revegetation site.
- 6 » Include spreading ground covers that protect the soil and trap water and nutrient runoff, thus reducing soil erosion, sedimentation and pollution of watercourses. Examples are rushes and sedges for creeklines / wet areas (e.g. *Juncus kraussii*, *Ficinia nodosa*, *Juncus pallidus*), low spreading shrubs and ground covers such as some *Acacia*, *Kennedia*, *Brachysemsa* species (now officially included with *Gastrolobium* genus but don't contain 1080), native pigfaces (*Carpobrotus* and *Disphyma*), and native grasses (e.g. wallaby grass, kangaroo grass, weeping rice grass and rush grass *Austrostipa juncifolia*).

SITE PREPARATION



- 1 » Retain old and large trees, dead or alive, as much as possible. They are important habitat for birds of prey which help control pests such as rabbits and mice, and bats to assist with insect pest management. Insectivorous bats eat up to twice their weight in insects every day.

Logs should also be retained because they provide homes for small mammals such as echidnas, as well as reptiles and invertebrates. If logs are obstructing planting routes, they can be pushed out of the way but not burnt.

- 2 » Waterlogged and / or salt affected soils should be mounded. If mounding in a separate pass to planting, mound in summer / early autumn to allow settlement and germination of weeds prior to planting.

Once mounded, don't allow stock onto mounded area or will damage the mounds. If grassy will need scarifying or scalping prior to mounding or will be cloddy and make poor mounds. Spray mounds after grasses have established on mounds, prior to planting.

- 3 » On rocky, difficult to access sites, a non-standard direct seeding approach might be required; seek technical assistance for these sites. Alternatively, deep ripping with a 3-point linkage ripper and spraying rip lines with appropriate herbicide might be the best option in preparation for planting seedlings with a pottiputki (hand-held tree planter).



Woody debris including hollow logs are important to keep as trap soil, litter and seeds and provide habitat; helping to crank up 'islands' of ecosystem function in degraded lands.



Mounding is needed on waterlogging-prone and saline soils. Contact NSPNR or the Gillamii Centre for availability of mounds.



Gen Harvey (Gillamii Centre) and Penni Hewett (South Coast NRM) planting seedlings into seeded soil using pottiputkis available from the North Stirlings Pallinup Natural Resources (NSPNR).

MACHINERY AND APPROACH



Broomehill farmer David Kinsey direct seeding with Chatfield Tree Planter with precision seeding attachment available from NSPNR.



Chatfield Tree Planter available from Gillamii Centre drops seed on soil surface. Heavy chain aiming to cover coarse seed and fine chain to cover fine seed.



CommVeg seeder enables optimal seed placement, which is critical on light sandy soils that are unable to retain moisture around the seed. For more information contact NSPNR.

A common tree planter that is fitted with a small seeds box can be used to direct sow native seeds (e.g. a Chatfield Tree Planter). Such equipment can be used to scalp 50mm of topsoil (to remove weed seeds), make a shallow rip (20-30cm deep), and scatter seed on the freshly disturbed soil.

It is advisable to drag a steel chain (or something similar) behind the machine to ensure shallow soil coverage over seed. This approach can be somewhat unreliable, deliver a non-uniform result and can be dramatically improved by modifying the machine so that the seed is placed in a stable soil environment at a precise depth.

Modified agricultural seeders can also be used to sow native plants, particularly native legumes (*Acacia* and *Kennedia*) and grasses. Proponents should however seek professional guidance as the sowing of natives is somewhat different to cereal crops and pastures.

While it might seem desirable to sow very quickly with a large modern air-seeder, the results are usually not as reliable as that achieved with machinery purpose built for native plants (modified tree planter or a purpose built native plant seeder such as a CommVeg seeder).

Agricultural machinery does a very poor job of sowing species such as many *Melaleuca* and *Eucalyptus* species. Higher seeding rates (double rates) should be used when seeding with standard agricultural machinery as this partially offsets lower seed use efficiency.

A local, purpose built, native plant seeder, the CommVeg seeder, is available. Contact your local NRM office to arrange hire. This machine can be used to scalp, rip and sow 1-3 lines per pass. On mounded wet sites it can be used to sow seeds on the top of tall mounds. Seedlings can either be planted by hand, with a pottiputki if already direct seeded, or from the back of a Chatfield Tree Planter.

PLANTING DESIGN



Unless planting on fragile non-wetting sand, row spacings can be around 2.5m centres. Allow room to get over with a machine for follow up applications for control of insect pests or post-emergent weed control in the following year after planting. It is ideal to get as many rows in as possible and practical to maximize the cover of native vegetation.

On light fragile soils, 4m row centres are recommended and avoid aligning planting rows with the prevailing wind direction to minimise the risk of soil erosion. Do not scalp downslope on sandy soils. It is recommended to plant on the contour where possible in non-water-logged sites to enable water to be retained on site. Along waterways, where practical, mound at 45° to the direction of water flow to allow drainage of water to the watercourse and minimise the risk of erosion from flood events.

Plant spacings within rows will depend on methods used and budget available. If direct seeding and seedlings, it is expected that 5m seedling spacings would be ample unless difficult conditions. Direct seeding is unsuitable for heavy clay soils and seedlings can be planted 1-2m apart. On salt scalds, direct seeding can be successful on mounds but it is a good idea to supplement with seedlings of species such as fiery bottlebrush (*Callistemon phoeniceus*) that can't cope with high salinity levels when germinating.

Established plant densities can be much higher when direct seeding than seedlings only. When all layers of vegetation are planted / seeded, it is not unrealistic to expect >4,000 stems/ha. To give a comparison with native bush regeneration 12 months post fire, over >40,000 stems/ha (including grasses) were recorded in a brown mallet *Eucalyptus astringens* woodland and >100,000 stems in a wandoo woodland east of Tambellup⁵.



Planting across a slope provides windbreak as well as linking up two remnants at each end (left 2000, right 2006).



Native hibiscus *Alyogyne huegelii* is an example of a pioneer species that grows quickly, produces lots of seed, and is short-lived.



Ground cover running postman *Kennedia prostrata* (foreground) grows well from seed on gravelly soil.



Weed control should be targeted while weeds are actively growing and before flowering to prevent weed seed set. If the site is near a wetland or waterway, it is preferable to use Roundup Bioactive® instead of Roundup® that contains surfactants that are known to damage frog development and can lead to decline or even loss of such fauna species¹. Alternately use a higher rate of glyphosate that doesn't contain surfactants with added spray-grade ammonium sulphate is suitable.

On previously cropped land and most pasture sites, an application of glyphosate 1-2lt/ha (450g/lt) with bifenithrin and 0.5-1.5kg/ha of Simazine® (900g/kg) applied to the site 3-4 weeks prior to establishment should deliver excellent control of pests and weeds. The scalping of the soil during seeding should remove residuals. On white-grey sandy sites do not use more than 0.5kg/ha of Simazine® (900g/kg).

There are no simple 'rules of thumb' for using herbicides and especially residual herbicides. Use of residual herbicides for weed control provides prolonged protection from weeds in the year of planting but needs to be considered in light of the following factors to prevent accidental plant deaths²:

- » **SOIL TYPE** - residuals such as Atrazine® and Simazine® are normally kept out of the root ball of seedlings because residuals bind with soil particles. However, they may not bind to coarse sands (e.g. river sand) and therefore may unexpectedly be found to leach into the root zone of the seedlings on these soils with adverse effects on plantings.
- » **pH** - residuals such as Ally® break down quickly in acid soils but don't break down in alkaline soils. Ally® can be used if needed for certain weeds that glyphosate alone may not provide adequate control such as: dock, sorrel, clover, erodium (corkscrew), sour sob and four o'clock. It is applied before sowing seed or planting seedlings provided there has been 25-50 mm rainfall and at least two weeks have elapsed since spraying on acid soils only.
- » **WHAT IS BEING PLANTED** - soluble residual herbicides are unsuitable for seed or seedling plantings unless targeted at species that aren't being planted such as grass selectives that can be used the year after planting such as Fuselade®, Verdict® (ie. when grasses haven't been planted!) and Taskforce® for African love grass.
- » **METHOD OF PLANTING** - don't spray weeds prior to mounding as the chemical will be bound up and concentrated in the mounds and cause problems for seed or seedling survival. Spray after mounding but only seedlings can be planted if insoluble residual herbicides used unless scalping off topsoil to remove chemical from the root zone of germinants.
- » **WHETHER PLANTING BY SEED AND / OR SEEDLINGS** - as a general rule, direct seeding can be carried out where insoluble residuals are used providing the top-soil is scalped off. Seedlings where insoluble residuals are used don't need to have the topsoil scalped provided mechanical methods of planting are used where the topsoil containing the chemical isn't squished in around the root ball.
- » **RAINFALL** - in addition to the above points, the potential action of leaching of chemical into the root zone of establishing seed germinants / seedlings needs to be considered in context with the method of planting. For example, Simazine® is safe for most seedlings when planted on mounds but if on flat ground and seedlings are planted into a rip line, chemical can be washed into the rip line where it is concentrated and filters down to the root zone and kills off seed / seedlings.

Good references for herbicide information include **Herbiguide** available online at herbiguide.com.au or **Southern Weed and Their Control** by John Moore and Judy Wheeler (2005), available from Department of Agriculture and Food WA (DAFWA).

Rabbits and excessive kangaroo numbers need to be managed prior to, during and after planting to ensure the survival of the planting. Where rabbits are a big problem on deep sands, fencing with rabbit netting might also be needed to achieve successful establishment. A number of Farmnotes on rabbit baiting are available from the DAFWA⁴. Assistance may also be available through the Red Card for Rabbits & Foxes program which may be accessed by contacting your local Landcare Office or South Coast NRM.

Most of the insect pests that cause damage to newly emerged crop and pasture plants also damage native plants, particularly at the cotyledon to six leaf stage. Preventative applications of insecticide are strongly recommended when direct seeding is used.

For example *Acacia*, *Atriplex*, and some eucalypts are extensively damaged by red-legged earth mite (RLEM). Many *Melaleuca* species (eg *M. hamata*) are not damaged by RLEM. Beetle larvae, Rutherglen bugs, weevils can all cause extensive damage to native plants before and after emergence and through to the several leaf stage. Locusts, wingless grasshoppers, beetles, weevils and Rutherglen bugs cause damage after germination, during the following spring-summer. Seedlings of all species become resistant to RLEM damage once they have reached the 6 leaf stage and thus nursery raised seedlings are not normally damaged by RLEM. Controlling RLEM is usually not required for seedling only projects. Adding insecticides into the weed control spray mix delivers good results. Adding, for example, bifenithrin and glyphosate together to control insects and weeds 21-28 days prior to sowing is highly effective. A follow up application of insecticide is usually required 2-10 weeks after sowing, depending on the results of the initial insect control.



Spiny rush Juncus acutus shown in this photo is a nasty weed easily distinguished from native rushes by stiff, needle-sharp tips and fan-shaped foliage is easily removed while in low numbers by digging out. Rapidly regenerates and completely covers an area, eliminating all other species and becoming impenetrable to humans and stock³. Grows on wet areas including saline sites.



Good weed control prior to direct seeding and seedling plantings is preferable to relying on post-emergent selective weed control strategies, and provides the opportunity for bare-earth residual insecticide application to protect direct seeding germinants from red-legged earth mite predation.



A seeding rate of about 0.5 kg per hectare for experienced practitioners is recommended; on difficult soils or for practitioners with little experience at a rate of 700-800g is recommended. In many cases (but not all), biodiversity mixes contain approximately 200-300g/ha of leguminous species, 200-300g of myrtaceous species and the remaining is made up of other species.

General rule of thumb for the seeding rates for trees (e.g. yate, flooded gum, jarrah, marri) is <150g/ha, mallees and melaleucas also <150g/ha, and rock sheoak (*Allocasuarina huegelliana*), that has very high seed use of efficiency, at <5g/ha.

Seed is normally mixed with bulking agents (e.g. fine spongelite, fine vermiculite). These additives increase the total volume of material to be sown and improve the metering (spread) of seed over a site and also assist the movement of seed through the cogs of a seedbox. Usually seed is mixed with bulking agent to form a final volume of 1-3 litres/km of row to be sown.

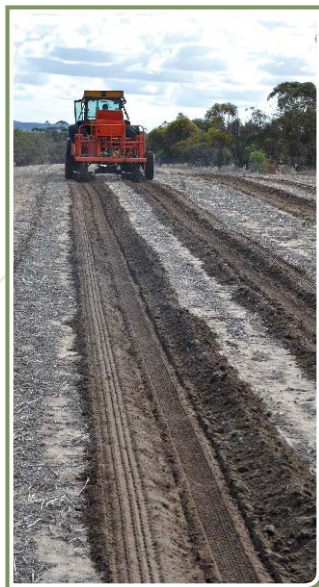
Fertiliser can be added to this mix but it is desirable to keep and sow fertiliser separately. Approximately 1-10kg of fertiliser can be sown or spread with the seed. It is important to use a low or no phosphorous fertiliser when proteaceous species (e.g. banksias and hakeas) are sown.

The seeder must be calibrated to deliver the desired amount of seed / bulking agent mix. Aim for 100-200ml of mix/100m of sowing line. To calibrate, simply take off one seed tube from the seed distributor, tie on a plastic bag, travel 100-200m with the drive wheel engaged, take off the bag and measure the volume of the mix in the bag. Use this information to determine sowing rate (litres of mix per km and per ha) and thus total volume of mix required to sow the site.

Seed Treatments

All legumes (eg *Acacia* and *Kennedia*) are hard-seeded and the seed must be scarified before sowing. The author (Geoff Woodall) routinely uses two 10 second immersions into boiling water (with an immersion in room temperature water between hot water immersion) with consistently good results.

It is very important that each kilogram of seed is placed in an excess (usually five times the volume) of boiling water, that heat is removed via a rinse in cool tap water and that the seed is then dried to its pre-scarification moisture content or bulked up and sown immediately. Mechanical scarification is also suitable though under and over scarification can be a problem.



Seeding with a precision seeder designed by Geoff Woodall (CommVeg seeder). Good weed control, precision sowing, and a stable soil environment are key to successful direct seeding.

For many Australian species treating the seed with smoke stimulates germination (breaks dormancy) and can improve seedling vigor. Smoke also has some desirable fungicidal properties. Many Australian species do not require any seed treatment (e.g. *Hakea laurina*, *Hakea nitida*), however to ensure they do not block the seed box it is recommended that the wings of seeds be removed (rubbed off) prior to sowing.

Timing

Optimum time of seeding differs according to climate - earlier in the more arid climates (e.g. mid-upper catchments) and later in wetter areas (e.g. lower Pallinup). Within a region, optimum time of sowing can vary with soil type (dry soils sown earlier, moist sites sown later). Time of sowing is also species dependent. Typically dry sites are sown late April-May and wet sites, late winter (late July).

Sowing Depth

Aim to sow most fine seeded species at a depth of 2-5mm; in soil prone to drying out (e.g. sand) or when dry seasonal conditions prevail increase the sowing depth by another 2-5mm or so. Sow larger seeds deeper at 10-20mm; in soil prone to drying out or when dry seasonal conditions prevail, increase the sowing depth by another 10mm or so.

Some large seeds (e.g. *Banksia*) do not germinate well at depth, and thus when legumes, larger seeded eucalypts and banksias are combined in a mix a sowing depth of 10-15mm is recommended. When sowing a simple legume mix (e.g. *Kennedia* species and *Acacia saligna* for forage) on light textured soils, sow seeds at a depth of 20-30mm.



An ideal scalp created by the CommVeg seeder. 5-7cm of soil being removed from the centre of each scalp, grading to 0cm on the outer sides of each scalp line.



Soil preparation achieved with the CommVeg seeder. The machine was travelling from left to right and the image shows the view behind the scalper, showing clean dirt being ripped (spring tyne), small tillage disks and the first wheel of the floating seeder arm which places the seed and presses the seed sowing trench.



Farms are often free of dieback because they don't have public access and can be a stronghold for spectacular species such as this bull banksia *Banksia grandis* provided care is taken not to introduce the dieback pathogen.

Approximately forty percent of native plants of south Western Australia are susceptible to dieback (*Phytophthora cinnamomi*). Dieback infestation is chronic on the South Coast (from Walpole to Esperance) where very few large patches of un-infested bush remain. It is therefore critical to the health of the bushland and associated fauna to keep dieback-free status where this still exists.

Landowners with dieback-free bush on private property have the greatest ability to protect these areas by controlling access and following hygiene protocols to prevent infection⁶.

Dieback is easily introduced with contaminated soil and spreads in the soil by water. Hence lower-landscape areas are most susceptible. Infection is most common in areas with rainfall >400mm but wet areas of the landscape in more arid areas are still capable of hosting the dieback fungus.

Strategies to minimise spread of dieback when undertaking revegetation:

- » Avoid revegetation in bushland that is able to regenerate naturally (e.g. isn't inundated with annual grasses) - eliminates the risk of introducing dieback through contaminated seedlings.
- » Consider direct seeding rather than planting seedlings where practical.
- » Purchase plants from nurseries with Nursery Industry Accreditation Scheme Australia (NIASA) accreditation.
- » Complete planting when soil is moist, but not wet.
- » If moving from one area of the bushland to another, ensure that all equipment and shoes are free of mud and soil. Brush soil from footwear and equipment and spray with solution (70% methylated spirits to 30% water) to disinfect between sites. Work from high points to low points in each paddock.
- » Do not use mulch, or only use mulch that has been well composted (the heating process kills *Phytophthora cinnamomi*)⁷.

More information about dieback can be found online at dieback.org.au

MALLET HILLS

» Breakaways or upper slopes and ridges on pink or reddish water repellent soils

» Maybe gravelly, often acidic » Blue and brown mallet



Breakaway

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Acacia acuminata</i>	jam	
<i>Alocasuarina huegeliana</i>	rock sheoak	associated with granite
<i>Eucalyptus astringens</i>	brown mallet	
<i>Eucalyptus falcata</i>		
<i>Eucalyptus gardneri</i> ssp. <i>gardneri</i>	blue mallet	
<i>Eucalyptus marginata</i> ssp. <i>marginata</i>	jarrah	if gravelly, not east Broomehill or NE Tambellup
<i>Eucalyptus pluricaulis</i> ssp. <i>pluricaulis</i>		
<i>Eucalyptus pluricaulis</i> ssp. <i>porphyrea</i>	purple leaved mallee	
<i>Eucalyptus thamnoides</i> / ssp. <i>megista</i>		
<i>Eucalyptus wandoo</i>	wandoo / white gum	
MID STOREY		
<i>Acacia saligna</i>	orange wattle	
<i>Alyogyne huegelii</i>	native hibiscus	
<i>Goodia medicaginea</i> *	clover-leaf poison	
<i>Rhagodia preissii</i> ssp. <i>preissii</i>		
LOWER STOREY		
<i>Acacia varia</i> ssp. <i>crassinervis</i>		
<i>Atriplex semibaccata</i>		
<i>Austrostipa variabilis</i>	native speargrass	
<i>Banksia armata</i>	prickly dryandra	if gravelly
<i>Brachysema praemorsum</i>	cut-leaf pea	
<i>Carpobrotus modestus</i>	inland pigface	
<i>Eutaxia microphylla</i> ssp. <i>microphylla</i>		
<i>Kennedia coccinea</i> ssp. <i>coccinea</i>		
<i>Neurachne alopecuioidea</i>	fox tail mulga	
<i>Rytidosperma caespitosum</i>	wallaby grass	

* maybe toxic to stock

Note - Dominant species shown in bold

POORLY DRAINED SANDY DUPLEX

- » Lower slopes, drainage lines and broad valley floors
- » Flooded gum, york gum and flat-topped yate woodlands

Acacia declinata



Salt-water paperbark



BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Acacia microbotrya</i>	manna wattle	
<i>Allocasuarina huegeliana</i>	rock sheoak	
<i>Corymbia calophylla</i>	marri	
<i>Eucalyptus cornuta</i>	yate	Cranbrook shire - sand, loam
<i>Eucalyptus decipiens</i>	moit	
<i>Eucalyptus occidentalis</i>	flat-topped yate	
<i>Eucalyptus orthostemon</i>		
<i>Eucalyptus phenax ssp. phenax</i>		Broomehill-Tambellup
<i>Eucalyptus rudis</i>	flooded gum	sand or loam
<i>Eucalyptus thamnoides ssp. megista</i>	brown mallee	
<i>Eucalyptus vegrandis ssp. recondita</i>		North Stirlings only
<i>Eucalyptus wandoo ssp. wandoo</i>	wandoo	
<i>Eucalyptus xanthonema ssp. xanthonema</i>		
<i>Melaleuca cuticularis</i>	salt-water paperbark	
<i>Melaleuca rhapsiophylla</i>	swamp paperbark	on larger watercourses
<i>Melaleuca strobophylla</i>		
MID STOREY		
<i>Acacia brachyclada</i>	Broomehill-Tambellup	
<i>Acacia cupularis</i>		
<i>Acacia saligna</i>	orange wattle	
<i>Alyogyne huegelii</i>	lilac hibiscus	
<i>Callistemon phoeniceus</i>	fiery bottlebrush	
<i>Callitris pyramidalis</i>	swamp cypress	
<i>Grevillea diversifolia ssp. subtersericata</i>		Cranbrook
<i>Hakea corymbosa</i>		
<i>Hakea varia</i>		
<i>Kunzea recurva</i>		
<i>Leptopsermum erubescens</i>	tea tree	on deeper sands
<i>Maireana brevifolia</i>	small leaf bluebush	
<i>Melaleuca acuminata</i>		north and eastern areas
<i>Melaleuca brophyi</i>		on flats
<i>Melaleuca brevifolia</i>		north and east
<i>Melaleuca densa</i>		west Cranbrook

Note - Dominant species shown in bold

BOTANICAL NAME	COMMON NAME	NOTES
<i>Melaleuca hamulosa</i>		
<i>Melaleuca ordinifolia</i>		
<i>Melaleuca pentagona</i>		
<i>Melaleuca spathulata</i>		seasonally wet flats, low ridges
<i>Melaleuca thyooides</i>		eastern areas
<i>Melaleuca thymoides</i>		
<i>Melaleuca viminea</i>		
<i>Regelia inops</i>		
<i>Rhagodia preissii ssp. preissii</i>		
<i>Templetonia retusa</i>	cockies tongues	east Cranbrook
<i>Viminaria juncea</i>	swish bush	
LOWER STOREY		
<i>Acacia declinata</i>		east Cranbrook
<i>Acacia glaucoptera</i>	clay wattle	east Cranbrook, Broomehill-Tambellup
<i>Acacia lasiocarpa var. sedifolia</i>		
<i>Acacia leptospermoides ssp. leptospermoides</i>		
<i>Acacia pulchella var. goadbyi</i>		
<i>Acacia sphaelata ssp. recurva</i>		
<i>Acacia stenoptera</i>	narrow winged wattle	
<i>Atriplex semibaccata</i>	creeping salt bush	
<i>Austrostipa elegantissima</i>	elegant spear grass	
<i>Austrostipa juncifolia</i>	rush grass / salt grass	
<i>Brachysema latifolium</i>		Cranbrook
<i>Brachysema sericeum</i>		Cranbrook
<i>Carpobrotus modestus</i>	inland pigface	
<i>Darwinia vestita</i>	pom-pom darwinia	Cranbrook only
<i>Dianella brevicaulis</i>		
<i>Ficinia nodosa</i>	knotted club rush	sand / dark sandy clay moist sites
<i>Hakea marginata</i>		
<i>Isopogon buxifolius</i>		sandy soils
<i>Juncus kraussii</i>	sea rush	wet sites
<i>Juncus pallidus</i>	pale rush	moist sites
<i>Kennedia coccinea ssp. coccinea</i>		

MODERATELY DRAINED SANDY DUPLEX

- » Crests, upper and lower slopes
- » Well drained sand or sandy loam over clay at 10-60 cm; seasonally perched water-table common
- » Wandoo & marri / york gum woodlands on moderately drained sandy duplex soils



York gum

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY (trees / mallees)		
<i>Acacia acuminata</i>	jam wattle	
<i>Acacia microbotrya</i>	manna wattle	
<i>Allocasuarina huegelliana</i>	rock sheoak	
<i>Eucalyptus decipiens</i>	moit	
<i>Eucalyptus loxophleba ssp. loxophleba</i>	york gum	Broomehill and east Tambellup only
<i>Eucalyptus phenax</i>		Broomehill-Tambellup
<i>Eucalyptus vegrandis ssp. recondita</i>		North Stirlings only
<i>Eucalyptus wandoo ssp. wandoo</i>	wandoo / white gum	
<i>Exocarpos sparteus</i>	native cherry	
<i>Hakea laurina</i>	pincushion hakea	
<i>Santalum acuminatum</i>	quandong	
MID STOREY (shrubs > 1m tall)		
<i>Acacia saligna</i>	orange wattle	
<i>Acacia sphacelata ssp. recurva</i>		
<i>Billardiera fusiformis</i>	bluebells	
<i>Calothamnus quadrifidus</i>	one-sided bottlebrush	
<i>Hakea corymbosa</i>	cauliflower hakea	
<i>Hakea lissocarpa</i>	honey bush	
<i>Hakea prostrata</i>	harsh hakea	
<i>Hakea trifurcata</i>	two-leaf hakea	
<i>Hakea undulata</i>	wavy-leaved hakea	
<i>Hypocalymma angustifolium</i>	honey myrtle	
<i>Leptospermum erubescens</i>	tea tree	
<i>Melaleuca hamata</i>	broom bush	
<i>Melaleuca spathulata</i>	purple honey myrtle	seasonally wet flats, low ridges
UNDER STOREY (shrubs < 1m, herbs)		
<i>Acacia consobrina</i>		
<i>Acacia lasiocarpa ssp. sedifolia</i>		
<i>Acacia stenoptera</i>	narrow winged wattle	
<i>Austrostipa elegantissima</i>	elegant spear grass	
<i>Bossiaea eriocarpa</i>	common brown pea	

Note - Dominant species shown in bold

BOTANICAL NAME	COMMON NAME	NOTES
<i>Brachysema praemorsum</i>	cut-leaf pea	
<i>Carpobrotus modestus</i>	inland pigface	
<i>Dianella brevicaulis</i>		
<i>Melaleuca carrii</i>		
<i>Melaleuca subtrigona</i>		
<i>Rhagodia preissii ssp. preissii</i>		



SALT-AFFECTED LAND

- » Valley floors, drainage lines and saline seeps on hillslopes
- » Salt-tolerant vegetation: samphire and barley grass
- » Salt-affected land

Melaleuca thyooides & *M. cuticularis*



SALT LAKES

- » Variable soils and seasonally waterlogged for species growing above wet area on deep sands, see deep pale sand
- » *Melaleuca* thickets

Salt lake in Balijup Wetland Suite

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Eucalyptus occidentalis</i>	flat-topped yate	on barley grass areas
<i>Eucalyptus othostemon</i>		
<i>Eucalyptus rudis</i>	flooded gum	on barley grass areas
<i>Eucalyptus vergrandis</i> ssp <i>recondita</i>		
<i>Melaleuca cuticularis</i>	saltwater paperbark	alluvium, sand, clay
<i>Melaleuca strobophylla</i>		clay, sandy silt
MID STOREY		
<i>Billardiera fusiformis</i>	bluebells	
<i>Callistemon phoeniceus</i>	fiery bottlebrush	
<i>Callitris pyramidalis</i>	swamp cypress	shallow duplex
<i>Melaleuca brevifolia</i>		
<i>Melaleuca hamulosa</i>		
<i>Melaleuca lateriflora</i>		
<i>Melaleuca ordinifolia</i>		
<i>Melaleuca thyooides</i>	salt-lake myrtle	
<i>Melaleuca viminea</i>		
LOWER STOREY		
<i>Acacia redolens</i> (prostrate form)	vanilla wattle	not local species (from Ongerup) but good habitat
<i>Atriplex semibaccata</i>	creeping saltbush	clay, sand, loam, laterite
<i>Austrostipa juncifolia</i>	rush-leaved grass	
<i>Enchylaena tomentosa</i> ssp <i>tomentosa</i>	ruby saltbush	
<i>Ficinia nodosa</i>	knotted club rush	sand, sandy clay, granite, limestone
<i>Juncus kraussii</i>	sea rush	white or grey sand, clay; high salt tolerance
<i>Juncus pallidus</i>	pale rush	
<i>Sporobolus virginicus</i>	marine couch	seedling only
<i>Verticordia plumosa</i>		on barley grass

Note - Dominant species shown in bold

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Eucalyptus phenax</i> ssp. <i>phenax</i>		not south western areas
<i>Eucalyptus occidentalis</i>	flat-topped yate	
<i>Eucalyptus orthostemon</i>		
<i>Eucalyptus spathulata</i>	swamp mallet	eastern areas
<i>Eucalyptus thamnoides</i>	brown mallee	on gravelly clay
<i>Melaleuca cuticularis</i>	salt-water paperbark	
<i>Melaleuca strobophylla</i>		
MID STOREY		
<i>Callistemon phoeniceus</i>	fiery bottlebrush	
<i>Callitris pyramidalis</i>	swamp cypress	
<i>Kunzea recurva</i>		
<i>Maireana brevifolia</i>	small leaf bluebush	
<i>Melaleuca acuminata</i>		eastern areas
<i>Melaleuca brevifolia</i>		
<i>Melaleuca densa</i>		western areas
<i>Melaleuca halmaturorum</i>		
<i>Melaleuca ordinifolia</i>		
<i>Melaleuca spathulata</i>		
<i>Rhagodia preissii</i> ssp. <i>preissii</i>		
LOWER STOREY		
<i>Acacia redolens</i>	vanilla wattle	
<i>Atriplex semibaccata</i>	creeping saltbush	
<i>Darwinia vestita</i>	pom-pom darwinia	Cranbrook
<i>Disphyma crassifolium</i>	round-leaved pigface	
<i>Ficinia nodosa</i>	knotted club rush	sand / sandy clay
<i>Juncus kraussii</i>	sea rush	
<i>Melaleuca carrii</i>		

Note - Dominant species shown in bold

GRAVEL RIDGES & SLOPES

» Hillcrests and upper slopes » Jarrah, marri, wandoo/mallee



BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Acacia acuminata</i>	jam	
<i>Allocasuarina huegelliana</i>	rock sheoak	
<i>Banksia grandis</i>	bull banksia	
<i>Corymbia calophylla</i>	marri	
<i>Eucalyptus astringens</i>	brown mallet	on gravelly clay
<i>Eucalyptus decipiens</i>	moit	
<i>Eucalyptus falcata</i>	silver mallee	
<i>Eucalyptus incrassata</i>	ridge-fruited mallee	
<i>Eucalyptus marginata ssp. marginata</i>	jarrah	not east Broomehill-Tambellup
<i>Eucalyptus phenax ssp. phenax</i>	white mallee / woodland mallee	
<i>Eucalyptus pluricaulis ssp. porphyrea</i>	purple-leaved mallee	
<i>Eucalyptus sporadica</i>		Broomehill-Tambellup
<i>Eucalyptus wandoo ssp. wandoo</i>	wandoo	
MID STOREY		
<i>Acacia myrtilifolia</i>		Cranbrook on sand / sandy gravel
<i>Agonis theiformis</i>		south west Cranbrook
<i>Banksia sessilis/var sessilis</i>	parrot bush	
<i>Banksia sphaerocarpa</i>	round-fruit banksia	
<i>Billardiera fusiformis</i>	bluebells	
<i>Bossiaea linophylla</i>	eggs and bacon	
<i>Calothamnus quadrifidus</i>	one-sided bottlebrush	
<i>Hakea prostrata</i>	harsh hakea	
<i>Hakea ruscifolia</i>	candle hakea	
<i>Hakea trifurcata</i>	two-leaf hakea	
<i>Hakea undulata</i>	wavy-leaved hakea	
<i>Jacksonia sternbergiana</i>	stinkwood	
<i>Melaleuca pentagona</i>		
<i>Melaleuca pungens</i>		
<i>Xanthorrhoea playtphylla</i>	grass tree	
LOWER STOREY		
<i>Acacia browniana ssp. intermedia</i>		
<i>Acacia chrysocephala</i>		
<i>Acacia drummondii ssp. elegans</i>		not Broomehill-Tambellup
<i>Acacia lasiocarpa var sedifolia</i>		

Note - Dominant species shown in bold

BOTANICAL NAME	COMMON NAME	NOTES
<i>Acacia pulchella ssp. pulchella</i>	prickly moses	
<i>Acacia stenoptera</i>	narrow winged wattle	
<i>Acacia varia ssp. crassinervis</i>		
<i>Astroloma compactum</i>		
<i>Astroloma pallidum</i>	kick bush	
<i>Austrostipa mollis</i>	native spear grass	
<i>Babingtonia camphorosmae</i>	camphor myrtle	
<i>Banksia armata</i>		clay gravel
<i>Banksia caleyi</i>	Cayley's banksia	east Cranbrook
<i>Banksia gardneri</i>		
<i>Billardiera variifolia</i>		
<i>Boronia spathulata</i>		
<i>Bossiaea eriocarpa</i>	common brown pea	
<i>Bossiaea ornata</i>	broad-leaved brown pea	
<i>Brachysema praemorsum</i>	cut-leaf pea	
<i>Calothamnus sanguineus</i>	silky-leaved blood flower	
<i>Conostylis aculeata</i>	prickly conostylis	
<i>Daviesia preissii</i>		
<i>Dillwynia laxiflora</i>		not north or east of Broomehill-Tambellup
<i>Hakea lehmanniana</i>	blue hakea	
<i>Hakea lissocarpha</i>	honey bush	
<i>Kennedia coccinea</i>	coral vine	
<i>Kennedia prostrata</i>	running postman	
<i>Kunzea preissiana</i>		upper Cranbrook catchment
<i>Macrozamia riedlei</i>	zamia palm	
<i>Melaleuca subtrigona</i>		west Cranbrook
<i>Neurachne alopecuroidea</i>	fox-tail mulga	
<i>Patersonia occidentalis</i>	purple flag	
<i>Pultenaea ericifolia</i>		
<i>Rytidosperma caespitosum / setaceum / acerosum</i>	wallaby grass	
<i>Stylidium repens</i>		
<i>Tetraria octandra</i>		
<i>Trachymene pilosa</i>	native parsnip	

ROCKY OUTCROPS

» Granite, dolerite, quartz and hard ironstone

» Wandoo, york gum

Silver mallee



BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Acacia acuminata</i>	jam	
<i>Allocasuarina huegeliana</i>	rock sheoak	
<i>Eucalyptus phenax</i> ssp. <i>phenax</i>	Port Lincoln mallee	eastern areas on flats, wet depressions
<i>Eucalyptus cornuta</i>	yate	Cranbrook only
<i>Eucalyptus falcata</i>	silver mallee	
<i>Eucalyptus incrassata</i>	ridge-fruited mallee	
<i>Eucalyptus loxophleba</i> ssp. <i>loxophleba</i>		Broomehill, east Tambellup and Cranbrook
<i>Eucalyptus phaenophylla</i>		
<i>Eucalyptus platypus</i>	moort	Broomehill-Tambellup
<i>Eucalyptus sporadica</i>		Broomehill-Tambellup
<i>Eucalyptus thamnoides</i> /ssp. <i>megista</i>	brown mallee	
<i>Eucalyptus vegrandis</i> ssp. <i>recondita</i>	clay mallee	
<i>Eucalyptus wandoo</i>	wandoo/white gum	
<i>Hakea laurina</i>	pincussion hakea	
MID STOREY		
<i>Acacia saligna</i>	orange wattle	
<i>Banksia mucronulata</i>		ironstone gravel/laterite
<i>Beaufortia cyrtodonta</i>		ironstone gravel
<i>Billardiera fusiformis</i>	bluebells	
<i>Calothamnus quadrifidus</i>	one-sided bottlebrush	
<i>Goodia medicaginea</i> *	clover-leaf poison	
<i>Hakea prostrata</i>	harsh hakea	
<i>Hakea trifurcata</i>	two-leaf hakea	
<i>Hakea undulata</i>	wavy-leaved hakea	
<i>Kunzea recurva</i>		
<i>Melaleuca pungens</i>		
<i>Melaleuca spathulata</i>		
LOWER STOREY		
<i>Acacia browniana</i> / ssp. <i>intermedia</i>		
<i>Acacia lasiocarpa</i> var <i>sedifolia</i>		
<i>Acacia varia</i> ssp. <i>crassinervis</i>		

Note - Dominant species shown in bold

BOTANICAL NAME	COMMON NAME	NOTES
<i>Austrostipa variabilis</i>	native speargrass	
<i>Banksia armata</i>	prickly dryandra	
<i>Banksia drummondii</i>		
<i>Banksia nivea</i>	honeypot dryandra	
<i>Bossiaea peduncularis</i>		Broomehill-Tambellup, east Cranbrook
<i>Calothamnus planifolius</i>		on gravelly clay
<i>Daviesia preissii</i>		
<i>Ficinia nodosa</i>	knotted club rush	where access to moisture
<i>Hakea lehmanniana</i>	blue hakea	
<i>Hakea lissocarpa</i>	honey bush	
<i>Hakea marginata</i>		in winter-wet areas
<i>Melaleuca subtrigona</i>		
<i>Microlaena stipoides</i>	weeping rice grass	
<i>Neurachne alopecuroidea</i>	fox-tail mulga	
<i>Themeda australis</i>	kangaroo grass	
<i>Trymalium ledifolium</i>		

* maybe toxic to stock

PALE DEEP SANDS

» Grey / white sand deeper than 80cm » Crests & slopes » Christmas tree, *Banksia attenuata*

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Acacia acuminata</i>	jam	
<i>Allocasuarina huegelliana</i>	rock sheoak	
<i>Banksia attenuata</i>	slender banksia	
<i>Banksia coccinea</i>	scarlet banksia	east Cranbrook
<i>Banksia grandis</i>	bull banksia	
<i>Corymbia calophylla</i>	marri	west of Tambellup and Cranbrook
<i>Eucalyptus angulosa</i>	ridge-fruited mallee	north Stirlings only
<i>Eucalyptus decipiens</i>	moit	
<i>Eucalyptus incrassata</i>	ridge-fruited mallee	
<i>Eucalyptus marginata</i> ssp. <i>marginata</i>	jarrah	not east Broomehill-Tambellup
<i>Eucalyptus phaenophylla</i>		north Stirlings, Broomehill, east Tambellup
<i>Eucalyptus phenax</i> ssp. <i>phenax</i>		Broomehill and east Tambellup
<i>Eucalyptus platypus</i>	moort	Broomehill-Tambellup
<i>Eucalyptus sporadica</i>		Broomehill, east Tambellup
<i>Eucalyptus uncinata</i>	hook-leaf mallee	
<i>Eucalyptus vegrandis</i> ssp. <i>recondita</i>	clay mallee (also grows on sand!)	Cranbrook and east Tambellup
<i>Nuytsia floribunda</i>	WA Christmas tree	plant seed near host 2nd year after planting
MID STOREY		
<i>Acacia brachyclada</i>		Broomehill-Tambellup
<i>Acacia cupularis</i>		
<i>Acacia cyclops</i>	rigid wattle	
<i>Acacia myrtifolia</i>		Cranbrook only
<i>Acacia saligna</i>	orange wattle	
<i>Acacia subcaerulea</i>		East Cranbrook
<i>Acacia triptycha</i>		Cranbrook
<i>Adenanthos cuneata</i>	coastal jugflower	
<i>Allocasuarina acuarina</i>		Broomehill-Tambellup
<i>Allocasuarina humilis</i>	dwarf sheoak	
<i>Allocasuarina lehmanniana</i>	dune sheoak	
<i>Banksia coccinea</i>	scarlet banksia	east Cranbrook
<i>Banksia sessilis</i>	parrot bush	
<i>Billardiera fusiformis</i>	bluebells	
<i>Calothamnus gracilis</i>		
<i>Calothamnus quadrifidus</i>	one-sided bottlebrush	
<i>Erema pauciflora</i>		
<i>Hakea corymbosa</i>		
<i>Hakea pandanicarpa</i> ssp. <i>crassifolia</i>		East Cranbrook

Note - Dominant species shown in bold

BOTANICAL NAME	COMMON NAME	NOTES
<i>Hakea preissii</i>		
<i>Hakea prostrata</i>	harsh hakea	
<i>Hakea trifurcata</i>	two-leaf hakea	
<i>Hakea undulata</i>		
<i>Hakea varia</i>		
<i>Jacksonia furcellata</i>	grey stinkwood	
<i>Kunzea ericifolia</i>	spearwood	
<i>Kunzea recurva</i>		
<i>Lambertia inermis</i> var. <i>inermis</i>	chittick	
<i>Leptospermum erubescens</i>	kerosene bush / roadside teatree	
<i>Leptospermum oligandrum</i>		
<i>Melaleuca spathulata</i>		wet flats, low ridges
<i>Melaleuca thymoides</i>		
<i>Regelia cymbifolia</i>		Broomehill-Tambellup
<i>Regelia inops</i>		
LOWER STOREY		
<i>Acacia cochlearis</i>		
<i>Acacia loricata</i> var. <i>loricata</i>		
<i>Astroloma baxteri</i>		
<i>Austrostipa elegantissima</i>	elegant spear-grass	
<i>Austrostipa variabilis</i>		
<i>Baeckea preissiana</i>		Cranbrook only
<i>Banksia caleyi</i>		east Cranbrook
<i>Banksia meisneri</i>	Meisner's banksia	Broomehill-Tambellup
<i>Banksia nutans</i>	nodding banksia	Cranbrook only
<i>Banksia repens</i>	creeping banksia	
<i>Brachysema praemorsum</i>	cut-leaf pea	
<i>Calytrix flavescens</i>	summer starflower	
<i>Carpobrotus modestus</i>	inland pigface	
<i>Conostylis setigera</i>		
<i>Dianella brevicaulis</i>		
<i>Hemiantra pungens</i>	snakebush	
<i>Kennedia coccinea</i>	coral vine	
<i>Kunzea preissiana</i>		
<i>Melaleuca carrii</i>		
<i>Melaleuca subtrigona</i>		
<i>Schoenus caespititius</i>		
<i>Stirlingia latifolia</i>	blueboy	Cranbrook, Kojonup
<i>Stylidium repens</i>	matted triggerplant	Cranbrook, Kojonup

RED SOILS OFTEN WITH GRAVEL & DYKES

» Red / Red-Brown soils » Upper to lower slopes » Jam, wandoo, flooded gum, marris

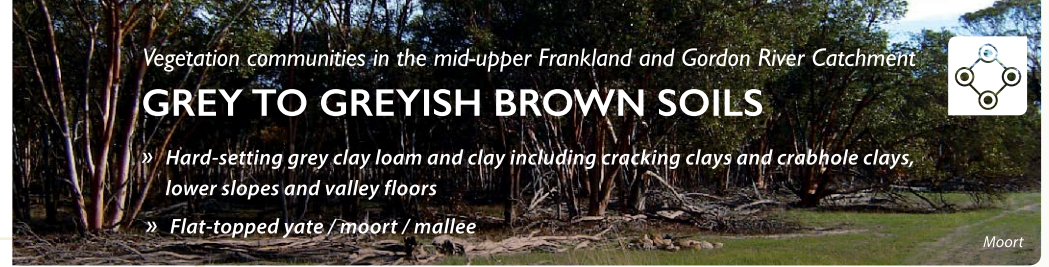


BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Acacia acuminata</i>	jam	
<i>Acacia microbotrya</i>	manna wattle	
<i>Allocasuarina huegeliana</i>	rock sheoaks	
<i>Corymbia calophylla</i>	marri	not east of Broomehill-Tambellup
<i>Eucalyptus cornuta</i>	yate	Cranbrook
<i>Eucalyptus rudis</i>	flooded gum	
<i>Eucalyptus wandoo sp. wandoo</i>	wandoo / white gum	
MID STOREY		
<i>Acacia extensa</i>		
<i>Acacia saligna</i>	orange wattle	
<i>Billardiera fusiformis</i>	bluebells	
<i>Bossiaea linophylla</i>	eggs and bacon	
<i>Calothamnus quadrifidus</i>	one-sided bottlebrush	
<i>Hakea prostrata</i>	harsh hakea	
<i>Hakea ruscifolia</i>		
<i>Hakea trifurcata</i>	two-leaf hakea	
<i>Hakea undulata</i>	wavy-leaved hakea	
<i>Jacksonia sternbergiana</i>	stinkwood	
UNDER STOREY		
<i>Acacia bidentata</i>		
<i>Acacia lasiocarpa var. sedifolia</i>		
<i>Bossiaea eriocarpa</i>	common brown pea	
<i>Brachysema praemorsum</i>	cut-leaf pea	
<i>Calothamnus planifolius</i>		
<i>Dianella brevicaulis</i>		
<i>Hakea lehmanniana</i>	blue hakea	
<i>Hakea lissocarpa</i>	honey bush	
<i>Rhodanthe manglesii</i>	pink everlasting	
<i>Hibbertia hemignosta</i>	buttercup	
<i>Juncus pallidus</i>	pale rush	
<i>Lechenaultia biloba</i>	blue lechenaultia	
<i>Lechenaultia formosa</i>	red lechenaultia	
<i>Microlanea stipoides</i>	weeping rice grass	
<i>Neurachne alopecuroidea</i>	fox-tail mulga	
<i>Pimelea ciliata ssp. ciliata</i>	white banjine	
<i>Pimelea suaveolens ssp. suaveolens</i>	scented banjine	
<i>Rytidosperma caespitosum</i>	wallaby grass	
<i>Sowerbaea laxiflora</i>	tassel flowers	
<i>Velleia trinervis</i>		

Note - Dominant species shown in bold

GREY TO GREYISH BROWN SOILS

» Hard-setting grey clay loam and clay including cracking clays and crabhole clays, lower slopes and valley floors
 » Flat-topped yate / moort / mallee



Moort

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Acacia acuminata</i>	jam	
<i>Eucalyptus phenax/spp. phenax</i>		
<i>Eucalyptus macrandra</i>	river yate	
<i>Eucalyptus occidentalis</i>	flat-topped yate	
<i>Eucalyptus thamnoides</i>	brown mallee	valley floors, undulating outcrops
<i>Eucalyptus vegrandis ssp. recondita</i>	clay mallee	
<i>Hakea laurina</i>	pincussion hakea	
<i>Hakea preissii</i>	needle tree	
<i>Melaleuca cuticularis</i>	salt-water paperbark	
MID STOREY		
<i>Acacia brachyclada</i>		Broomehill-Tambellup
<i>Acacia cupularis</i>		
<i>Acacia saligna</i>	orange wattle	
<i>Callistemon phoeniceus</i>	fiery bottlebrush	
<i>Gastrolobium spinosum*</i>	prickly poison	
<i>Hakea corymbosa</i>	cauliflower hakea	
<i>Hakea varia</i>	variable-leaved hakea	
<i>Melaleuca acuminata</i>		
<i>Melaleuca brevifolia</i>	mallee myrtle	
<i>Melaleuca brophyi</i>		
<i>Melaleuca hamata</i>	broom bush	
<i>Melaleuca spathulata</i>	purple honey myrtle	
<i>Melaleuca thyoides</i>	salt-lake honey myrtle	
<i>Melaleuca torquata</i>		east Broomehill-Tambellup
<i>Melaleuca viminea</i>	Mohan	
UNDER STOREY		
<i>Acacia bidentata</i>		
<i>Acacia erinacea</i>		Broomehill-Tambellup
<i>Acacia ferocior</i>		
<i>Acacia glaucoptera (prostrate form)</i>	clay wattle / flat wattle	
<i>Acacia lasiocarpa var. sedifolia</i>		
<i>Allocasuarina microstachya</i>		
<i>Austrostipa juncifolia</i>	rush-leaved grass	low, wet areas
<i>Banksia armata</i>		
<i>Hakea lissocarpa</i>		
<i>Melaleuca subtrigona</i>		
<i>Verticordia plumosa</i>	plumed feather-flower	

Note - Dominant species shown in bold

*contains 1080, toxic to stock

STIRLING RANGE OUTLIER COMPLEX



» Upper slope, on rocky yellow brown loam to clay loam recorded from a range of sites on similar geology to Sukey Hill, Cranbrook

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Eucalyptus preissiana</i>	bell-fruited mallee	
<i>Eucalyptus decipiens</i>	moit	
<i>Eucalyptus falcata</i>	silver mallee	
<i>Eucalyptus xanthonema</i>		
<i>Eucalyptus lehmannii</i> ssp. <i>parallela</i>		
<i>Eucalyptus marginata</i>	jarrah	
<i>Eucalyptus pleurocarpa</i>		
MID STOREY		
<i>Banksia sphaerocarpa</i> ssp. <i>sphaerocarpa</i>	round-fruit banksia	
<i>Beaufortia anisandra</i>		
<i>Calothamnus quadrifidus</i>	one-sided bottlebrush	
<i>Hakea ambigua</i>		
<i>Hakea baxteri</i>		
<i>Hakea cygna</i>		
<i>Hypocalymma angustifolium</i>	honey myrtle	
<i>Kunzea micromera</i>		
<i>Kunzea recurva</i>		
<i>Melaleuca spathulata</i>		
<i>Taxandria spathulata</i>		
<i>Xanthorrhoea platyphylla</i>		
LOWER STOREY		
<i>Acacia squamata</i>		
<i>Alocasuarina humilis</i>		
<i>Alocasuarina thuyoides</i>		
<i>Banksia armata</i>		
<i>Banksia drummondii</i>		
<i>Banksia tenuis</i> ssp. <i>tenuis</i>		
<i>Beaufortia schaueri</i>		
<i>Calothamnus sanguineus</i>		
<i>Darwinia vestita</i>	pom-pom darwinia	
<i>Hakea lehmanniana</i>	blue hakea	
<i>Melaleuca villosisepala</i>	hairy Melaleuca	
<i>Neurachne alopecuroidea</i>	fox-tail mulga	
<i>Verticordia habrantha</i>		

STIRLING RANGE OUTLIER COMPLEX



» Balicup Rd / Hamila Hill Rd, CB *Lambertia ericifolia* / *Banksia coccinea* tall shrubland light grey / pink sand mid slope, adapted from Sandiford 2012, pp. 32, 36

BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Lambertia ericifolia</i>	heath-leaved honeysuckle	
<i>Banksia coccinea</i>	scarlet banksia	
MID STOREY		
<i>Melaleuca thymoides</i>		
<i>Jacksonia grevilleoides</i>		
<i>Adenanthos cuneatus</i>	coastal jug-flower	
UNDER STOREY		
<i>Schoenus curvifolius</i>		
<i>Caustis diocia</i>		
<i>Stylidium repens</i>	matted trigger plant	
<i>Rytidosperma acerosum</i>	syn. wallaby grass	

WET SOIL

- » Various soils which are waterlogged from 30 to 80 cm or less for a major part of the year
- » Swamps, lakes, non-saline hillside seeps
- » Flooded gum, flat-topped yate

Flat-topped yate, pale rush understory



BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Acacia microbotrya</i>	manna wattle	
<i>Allocasuarina huegelliana</i>	rock sheoak	
<i>Banksia littoralis</i>	swamp banksia	on grey or black peaty sand
<i>Corymbia calophylla</i>	marri	
<i>Eucalyptus decipiens</i>	moit	
<i>Eucalyptus occidentalis</i>	flat-topped yate	sand or clay soils
<i>Eucalyptus rudis</i>	flooded gum	sand or loam
<i>Eucalyptus vegrandis</i> ssp. <i>recondita</i>	clay mallee	
<i>Eucalyptus wandoo</i>	wandoo	
<i>Melaleuca cuticularis</i>	salt-water paperbark	
<i>Melaleuca preissiana</i>	fresh-water paperbark	on sandier soils
<i>Melaleuca rhapsiophylla</i>	swamp paperbark	range of soil types
<i>Melaleuca strobophylla</i>		on heavier soils
MID STOREY		
<i>Acacia extensa</i>		
<i>Acacia saligna</i>	orange wattle	
<i>Billardiera fusiformis</i>	bluebells	
<i>Hakea ceratophylla</i>		Cranbrook
<i>Hakea corymbosa</i>	cauliflower hakea	
<i>Hakea prostrata</i>		
<i>Hakea varia</i>		
<i>Kunzea micromera</i>		
<i>Kunzea recurva</i>		
<i>Melaleuca densa</i>		heavier soil
<i>Melaleuca hamulosa</i>		heavier soil
<i>Melaleuca lateritia</i>	robyn redbreast bush	west Cranbrook / southwest Kojonup
<i>Melaleuca spathulata</i>		
<i>Melaleuca thymoides</i>		sandier soils
<i>Melaleuca viminea</i>		
<i>Pericalymma ellipticum</i>	swamp teatree	Cranbrook, Kojonup, sand, clayey sand, gravel

Note - Dominant species shown in bold

BOTANICAL NAME	COMMON NAME	NOTES
<i>Pericalymma spongiocaula</i>		
<i>Viminaria juncea</i>	swish bush	
LOWER STOREY		
<i>Sporobolus virginicus</i>	marine couch	
<i>Acacia pulchella</i> var. <i>goadbyi</i>		
<i>Baumea articulata</i>	jointed rush	indicator of fresh water grows in emergent zone*
<i>Baumea juncea</i>	bare twigrush	
<i>Brachysema latifolium</i>		Cranbrook
<i>Brachysema melanopetalum</i>	black-flowered pea	
<i>Brachysema sericeum</i>		Cranbrook
<i>Calothamnus lateralis</i>		west Cranbrook
<i>Cyathochaeta avenacea</i>		Cranbrook
<i>Dianella brevicaulis</i>		
<i>Juncus pallidus</i>	pale rush	
<i>Melaleuca violacea</i>		
<i>Patersonia occidentalis</i>	purple flag	
<i>Verticordia plumosa</i>	plumed feather-flower	

YELLOW & BROWN DEEP SANDS

- » Valley floors, often as low dunes & on slopes
- » *Banksia*, Christmas tree, paperbarks, sheoak

Banksia attenuata, rock sheoak & jam wattle



Banksia attenuata with flat-topped yate



BOTANICAL NAME	COMMON NAME	NOTES
UPPER STOREY		
<i>Acacia acuminata</i>	jam	
<i>Acacia microbotrya</i>	manna wattle	
<i>Allocasuarina huegeliana</i>	rock sheoak	
<i>Eucalyptus falcata</i>	silver mallee	
<i>Eucalyptus incrassata</i>	ridge-fruited mallee	
<i>Eucalyptus phaenophylla</i>		
<i>Eucalyptus phenax</i> ssp. <i>phenax</i>		
<i>Banksia attenuata</i>	slender banksia	
<i>Eucalyptus marginata</i> ssp. <i>marginata</i>		mallee form
<i>Nuytsia floribunda</i>	WA Christmas tree	plant seed near host 2nd year after planting
MID STOREY		
<i>Acacia brachyclada</i>		Broomehill-Tambellup
<i>Acacia saligna</i>	orange wattle	
<i>Acacia triptycha</i>		Cranbrook
<i>Allocasuarina humilis</i>	dwarf sheoak	
<i>Banksia sessilis</i> / var. <i>sessilis</i>	parrot bush	
<i>Billardiera fusiformis</i>	bluebells	
<i>Hakea corymbosa</i>	cauliflower hakea	
<i>Hakea lissocarpha</i>	honey bush	
<i>Hakea prostrata</i>	harsh hakea	
<i>Hakea ruscifolia</i>	candle hakea	
<i>Hakea trifurcata</i>	two-leaf hakea	
<i>Hakea undulata</i>		
<i>Jacksonia furcellata</i>	grey stinkwood	
<i>Leptospermum erebescens</i>	teatree	
LOWER STOREY		
<i>Acacia loricata</i> var. <i>loricata</i>		
<i>Acacia lasiocarpa</i> var. <i>sedifolia</i>		
<i>Allocasuarina microstachya</i>		
<i>Banksia repens</i>	creeping banksia	
<i>Bossiaea eriocarpa</i>	common brown pea	

Note - Dominant species shown in bold

BOTANICAL NAME	COMMON NAME	NOTES
<i>Darwinia vestita</i>		
<i>Ficinia nodosa</i>	knotted club rush	valley floors
<i>Hakea lehmanniana</i>	blue hakea	
<i>Hypocalymma angustifolia</i>	honey myrtle	
<i>Juncus pallidus</i>	pale rush	valley floors
<i>Melaleuca carrii</i>		
<i>Melaleuca subtrigona</i>		
<i>Neurachne alopecuroidea</i>	fox-tail mulga	
<i>Patersonia occidentalis</i>	purple flag	
<i>Themeda triandra</i>	kangaroo grass	

GLOSSARY

» **BIODIVERSITY**

Biodiversity is the variety of all life - the different plants, animals and micro-organisms - the genes they contain and the ecosystems of which they form part.

» **COMMUNITY**

An assemblage of species populations that occur together in the same place at the same time.

» **NSPNR**

North Stirlings Pallinup Natural Resources

» **ECOSYSTEM**

Includes all the animals, plants and physical interactions of a defined space.

» **RESILIENCE**

The ability of a community to return to its original state following displacement.

» **RESISTANCE**

The ability of a community to avoid displacement.

» **STABILITY**

Involves two components: resilience and resistance⁸.

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Note: Soil-landscape information contained in vegetation community tables follows Stuart-Street, 2002 (9) and Stuart Street and Maygold (in prep.) (10), Beard 1979 (11) and Land Monitor Project, 2001 (12) cited Sounness & Whitfield, 2007 (13).



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